REMARKS

Claims 13-24 were previously pending in the application. This Amendment amends claims 13, 15, 23, and 24. Claims 14 and 16-22 remain unchanged. New claim 25 is added. Claims 13, 23, 24, and 25 are independent.

This Amendment is accompanied by an excess claim fee payment letter for one (1) excess independent claim.

The Specification Objections

The disclosure is objected to because of informalities. This Amendment amends the specification to include section headings, thereby obviating this objection.

Applicants respectfully request withdrawal of this objection.

The Rejections under 35 U.S.C. § 112, second paragraph

The Office Action rejects claims 15 and 18 under 35 U.S.C. 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

This Amendment amends claim 15 to particularly point out and distinctly claim the subject matter which applicant regards as the invention, thereby overcoming this rejection.

With respect to claim 18, Applicants respectfully submit that the feature "supply voltage" clearly is introduced in claim 13 at line 14. Therefore, claim 18 has sufficient antecedent basis for this feature. Claim 18 is clear and definite.

Applicants respectfully request withdrawal of these rejections.

The Claimed Invention

An exemplary embodiment of the claimed invention, as recited by, for example, independent claim 13, is directed to a circuit arrangement for protecting from overheating a heating element whose resistance value is a function of its temperature, the circuit arrangement comprising a current sensor means coupled to the heating element, the

output of the current sensor providing a signal proportional to the current flowing through the heating element; a first scaling means whose output provides a signal proportional to a the supply voltage of the heating element; a first detector means having inputs each coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector means having an output that provides *a difference signal* formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare *the difference signal* determined by the first detector means with a reference signal, the switch control circuit being operatively connected to the evaluation circuit such that the switch control circuit can be switched from the first state into the second state by the evaluation circuit.

The present invention provides an electronic fuse for the fused protection against damage of a heating device for fluids comprising a heating element. In this method, the resistance value of the heating element is a function of its temperature and the change in the resistance is detected and compared with a reference signal. Depending on the comparison, the heating circuit is optionally interrupted by means of a switching means.

As explained in the present application, it is not possible to directly measure the resistance of the heating element since this is acted upon by the supply voltage during operation. The resistance must therefore be calculated indirectly by measuring the current through the heating element and the voltage at the heating element. The present invention explains that, according to Ohm's law, the ratio of voltage to current must be determined for this purpose. However, while it is possible to determine the ratio of voltage to current, this process is laborious.

Therefore, instead of determining the ratio of voltage to current, the present invention uses an approximation of ratio formation (division) by a Taylor series expansion and discontinues this after the second term. Instead of using the ratio or division, the present invention uses a subtraction of voltage and current (i.e., a difference signal) which can be implemented very simply in circuit technology by the first detector means. This means that a descending line is obtained from the division hyperbola. The error thereby incurred does not play a fundamental role for the function of the circuit

arrangement if both terms are normalised to the same quantity before the analogue subtraction of voltage and current. This is achieved on the one hand by the first scaling means which normalises the current. The operating voltage of the heating element can be reduced to the desired value by a voltage divider, which is the first scaling means. The current through the heating element flows through a shunt across which a voltage proportional to the current is produced. See, e.g., page 4, lines 9-22, paragraph [018].

In this manner, the present invention provides a circuit arrangement for protecting a heating element from overheating which is simple, fast and cost-effective, thereby providing a heating element protected from overheating and a method for protecting such a device. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

The Rejections under 35 U.S.C. § 102

In the Office Action, claims 13-15, 23 are rejected under 35 U.S.C. 102(b) as being anticipated by the Cage et al reference (US 4,198,957). Claim 24 is rejected under 35 U.S.C. 102(b) as being anticipated by the Gava et al reference (EP 0 579 947). Applicants respectfully traverse these rejections.

The Rejection over the Cage et al reference

Claims 13-15, 23 are rejected under 35 U.S.C. 102(b) as being anticipated by the Cage et al reference.

Applicants respectfully traverse this rejection.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. […] The identical invention must be shown in as complete detail as is contained in the ... claim." M.P.E.P. § 2131.

Applicants respectfully submit that the Cage et al reference does not disclose the features of the claimed invention including a current sensor means coupled to the heating element, the output of the current sensor providing a signal proportional to the current flowing through the heating element; a first scaling means whose output provides a signal

proportional to a the supply voltage of the heating element; a first detector means having inputs each coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector means having an output that provides *a difference signal* formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare *the difference signal* determined by the first detector means with a reference signal, the switch control circuit being operatively connected to the evaluation circuit such that the switch control circuit can be switched from the first state into the second state by the evaluation circuit, as recited in independent claim 13.

As explained above, instead of using the ratio or division, the present invention uses a subtraction of voltage and current (i.e., a difference signal) which can be implemented very simply in circuit technology by the first detector means. See, e.g., page 4, lines 9-22, paragraph [018]. These features are important for providing a method for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

The Office Action alleges that the Cage et al reference discloses the features of the invention. Particularly, the Office Action takes that position that the Cage et al. reference discloses a current sensor means coupled to the heating element, the output of the current sensor providing a signal proportional to the current flowing through the heating element because "the resistor 37 may be tapped for measuring current and provides a signal proportional to the heating element."

Contrary to the assertions in the Office Action, Applicants respectfully submit that the Cage et al reference very clearly does not disclose or suggest all of the features of independent claims 13 and 23.

For example, Applicants respectfully submit that the Cage et al reference does not disclose or suggest at least a current sensor means coupled to the heating element, the output of the current sensor providing a signal proportional to the current flowing through the heating element; a first scaling means whose output provides a signal proportional to a the supply voltage of the heating element; a first detector means having inputs each

coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector means having an output that provides *a difference signal* formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare *the difference signal* determined by the first detector means with a reference signal, the switch control circuit being operatively connected to the evaluation circuit such that the switch control circuit can be switched from the first state into the second state by the evaluation circuit, as recited for example in claim 13.

Particularly, Applicants respectfully submit that the Cage et al reference does not disclose that the resistor 37 is tapped for measuring current and provides a signal proportional to the heating element. More particularly, the Cage et al reference does not disclose the first detector means having an output that provides *a difference signal* formed from the signals of the current sensor means and the scaling means.

Instead, the Cage et al reference discloses that if the operating temperature of the element 13 exceeds the set value due to thermal overshoot upon removal of the element 13 from contact with skin tissue, the phase of the error signal 33 with respect to the applied line signal reverses, thereby triggering the pulse generators to supply conduction-initiating pulses to the gage electrodes of the controlled rectifiers 21, 23 during alternate half cycles when the rectifiers are back biased. This decreases the power to the element 13 and causes the operating temperature to drop to the set value.

In stark contrast, the present invention provides a circuit arrangement comprising a current sensor means coupled to the heating element, the output of the current sensor providing a signal proportional to the current flowing through the heating element; a first scaling means whose output provides a signal proportional to a the supply voltage of the heating element; a first detector means having inputs each coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector means having an output that provides a difference signal formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare the difference signal determined by the first detector means with a reference signal, the switch control circuit being operatively connected to the evaluation circuit

such that the switch control circuit can be switched from the first state into the second state by the evaluation circuit, as recited in claim 13.

As explained above, these features are important for providing a circuit arrangement for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

For at least the foregoing reasons, the Cage et al reference very clearly does not disclose all of the features recited by independent claims 13 and 23.

Applicants respectfully request withdrawal of this rejection.

The Rejection over the Gava et al reference

Claim 24 is rejected under 35 U.S.C. 102(b) as being anticipated by the Gava et al reference. Applicants respectfully traverse this rejection.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. [...] The identical invention must be shown in as complete detail as is contained in the ... claim." M.P.E.P. § 2131.

Independent claim 24 recites a method comprising detecting change in the resistance using *a difference signal* formed from a signal proportional to a current flowing through the heating element and a signal proportional to a supply voltage of the heating element; and comparing the detected change in the resistance with a reference signal and selectively interrupting the heating circuit by means of a switch means in dependence upon the comparison of the detected change in the resistance with a reference signal.

As explained above, instead of using the ratio or division, the present invention uses a subtraction of voltage and current which can be implemented very simply in circuit technology by the first detector means. See, e.g., page 4, lines 9-22, paragraph [018]. These features are important for providing a method for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

The Gava et al reference very clearly does not disclose at least these features of independent claim 24. Instead, the Gava et al reference discloses that the microprocessor 17 is arranged to compute the ratio between said voltage signal and said current signal.

In contrast, the claimed invention is configured to use a subtraction of voltage and current (i.e., a difference signal) which can be implemented very simply in circuit technology by the first detector means, not a ratio or division.

The Gava et al reference very clearly does not disclose a method comprising detecting change in the resistance using a difference signal formed from a signal proportional to a current flowing through the heating element and a signal proportional to a supply voltage of the heating element, as recited by independent claim 24.

As explained above, these features are important for providing a circuit arrangement for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

Applicants respectfully request withdrawal of this rejection.

The Rejections under 35 U.S.C. § 103

In the Office Action, claims 16, 17, 19, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Cage reference in view of the Luy et al reference (US 4,035,692). Claims 18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Cage reference, the Luy et al reference, and in further view of the Abe et al reference (US 4,516,543).

Applicants respectfully traverse these rejections.

Applicants respectfully submit that none of the applied references discloses or suggests the features of the claimed invention including a circuit arrangement comprising a current sensor means coupled to the heating element, the output of the current sensor providing a signal proportional to the current flowing through the heating element; a first scaling means whose output provides a signal proportional to a the supply voltage of the heating element; a first detector means having inputs each coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector

means having an output that provides a difference signal formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare the difference signal determined by the first detector means with a reference signal, the switch control circuit being operatively connected to the evaluation circuit such that the switch control circuit can be switched from the first state into the second state by the evaluation circuit, as recited in independent claim 13, from which claims 16-21 depend.

As explained above, instead of using the ratio or division, the present invention uses a subtraction of voltage and current (i.e., a difference signal) which can be implemented very simply in circuit technology by the first detector means. See, e.g., page 4, lines 9-22, paragraph [018]. These features are important for providing a method for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

The Cage reference very clearly does not teach or suggest these features at least for the reasons set forth above.

Applicants respectfully submit that the Luy et al reference and the Abe et al reference do not remedy the deficiencies of the Cage reference. Indeed, the Office Action does not rely on these references for these features of the claimed invention.

None of the applied references discloses or suggests the subject matter defined by independent claim 13, from which claims 16-21 depend.

Applicants respectfully request withdrawal of these rejections.

New Claim

New claim 25 is added. New claim 25 corresponds to the features of claim 13 without means-plus-function language. None of the applied references discloses or suggests the subject matter defined by independent claim 25 for at least the same reasons as those set forth above with respect to independent claim 13.

CONCLUSION

In view of the above, entry of the present Amendment and allowance of Claims 13-25 are respectfully requested. If the Examiner has any questions regarding this amendment, the Examiner is requested to contact the undersigned. If an extension of time for this paper is required, petition for extension is herewith made.

Respectfully submitted,

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